

DRAFT
MIXING ZONE EVALUATION WORK PLAN

PATRICK BAYOU SUPERFUND SITE REMEDIAL INVESTIGATION
DEER PARK, TEXAS

Prepared for

Patrick Bayou Joint Defense Group

Prepared by

Anchor Environmental, L.L.C.
2113 Government Street
Building D Suite 3
Ocean Springs, Mississippi 39564

October 2008



DRAFT
MIXING ZONE EVALUATION WORK PLAN

PATRICK BAYOU SUPERFUND SITE REMEDIAL INVESTIGATION
DEER PARK, TEXAS

Prepared for

Patrick Bayou Joint Defense Group

Prepared by

Anchor Environmental, L.L.C.
2113 Government Street
Building D Suite 3
Ocean Springs, Mississippi 39564

October 2008

Table of Contents

1	INTRODUCTION AND PURPOSE	5
1.1	Overall Objectives	5
1.2	Site Description	5
2	SAMPLING DESIGN AND RATIONALE.....	8
2.1.1	Objectives and Rationale.....	8
2.1.2	Study Design	9
3	LABORATORY ANALYTICAL METHODS, QUALITY CONTROL, AND MEASUREMENT QUALITY OBJECTIVES.....	13
4	FIELD ACTIVITY METHODS AND PROCEDURES.....	14
4.1	Project Organization, Schedule, and Contacts.....	14
4.2	Access and Sampling Permission	14
4.3	Utility Clearances.....	14
4.4	Equipment, Supplies, and Sampling Containers.....	15
4.5	Surveying	15
4.6	Sample Collection Procedures.....	15
4.7	Sediment Processing.....	16
4.7.1	High-Resolution Cores.....	17
4.8	Decontamination.....	18
4.9	Field Quality Assurance/Quality Control (QA/QC).....	19
4.9.1	Field Quality Assurance Samples.....	19
4.9.2	Performance Audits and Corrective Actions	19
4.10	Investigation Derived Waste Handling and Tracking.....	19
4.10.1	Sediment.....	19
4.10.2	Decontamination and Rinse Water.....	20
4.10.3	PPE and Solid Waste	20
5	MEASUREMENT AND DATA ACQUISITION	21
5.1	Field Documentation and Sediment Sample Identification	21
5.1.1	Sample Identification.....	22
5.2	Sample Handling and Transport	22
5.2.1	Field Custody	23
5.2.2	Laboratory Sample Custody.....	23
5.2.3	Sample Packing and Shipping	24
6	REFERENCES	26

List of Tables

Table 1	Summary of High-Resolution Sediment Core Study Design
Table 2	Parameters for Analysis and Target Practical Quantitation Limits



Table of Contents

Table 3	Laboratory Quality Control Sample Summary
Table 4	Laboratory Measurement Objectives for Sediment Samples
Table 5	Sample Containers, Preservatives, and Holding Times
Table 6	Summary of Sampling Station Location Coordinates

List of Figures

Figure 1	Site Location, Patrick Bayou Superfund Site, Deer Park, Texas
Figure 2	Predicted Sedimentation Rates and Proposed Vertical Coring Locations
Figure 3	Proposed High-Resolution Sediment Core Processing Scheme



List of Acronyms and Abbreviations

Anchor	Anchor Environmental, L.L.C.
AOC	Administrative Order on Consent
cm	centimeter
COC	chain-of-custody
COPC	contaminants of potential concern
CSM	Conceptual Site Model
DGPS	Differential Global Positioning System
FS	Feasibility Study
GPS	Global Positioning System
GSD	grain size distribution
HDPE	high-density polyethylene
HSC	Houston Ship Channel
JDG	Patrick Bayou Joint Defense Group
NAD 83	North American Datum of 1983
NAPL	non-aqueous phase liquid
NSR	net sedimentation rate
PAHs	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyls
POC	points of contact
PPE	personal protective equipment
PSCR	Preliminary Site Characterization Report
PTFE	polytetrafluoroethylene
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QAP	Quality Assurance Plan
QAPP	Quality Assurance Project Plan
QEA	Quantitative Environmental Analysis, L.L.C.
RI	Remedial Investigation
Site	Patrick Bayou Superfund Site
SOP	Standard Operating Procedures
TMDL	Total Maximum Daily Load
TOC	total organic carbon
TSS	total suspended solids



List of Acronyms and Abbreviations

USEPA United States Environmental Protection Agency



1 INTRODUCTION AND PURPOSE

This Work Plan describes the rationale, objectives, study design, and methods for an investigation of sediments within the Patrick Bayou Superfund Site (Site) in Deer Park, Texas to supplement data collected under Work Package 2 tasks outlined in the Remedial Investigation (RI) Work Plan (Work Package 2 Work Plan; Anchor 2007b), and data collected under the Supplemental Work Plan (Supplemental Work Plan; Anchor 2007d).

The Work Plan is being conducted by the Patrick Bayou Joint Defense Group (JDG) in response to an Administrative Order on Consent (AOC) and Settlement Agreement with the U.S. Environmental Protection Agency (USEPA) dated January 31, 2006. The AOC concerns the performance of a Remedial Investigation/Feasibility Study (RI/FS) at the Site. The proposed field work scope was developed based on review of the results of Work Package 2 and Supplemental Work Plan evaluations, along with recent risk evaluations and sediment transport modeling.

1.1 Overall Objectives

Ten high-resolution sediment cores will be collected to determine the depth of the sediment mixing zone at the Site. It is anticipated that this effort will be completed over a 1 to 2 week period, depending on tide and weather conditions. This mixing zone is defined by the depth of active biological burrowing (bioturbation) and the physical processes of scour, resuspension, and deposition of sediment by hydrodynamic forces. The results of this investigation will be used to improve the predictive capability of the site sediment transport model described in Work Package 2 (Anchor 2007b) and the Supplemental Work Plan (Anchor 2007d).

The evaluations that are proposed as part of this Work Plan were developed to provide information that can be utilized to further refine the Conceptual Site Model (CSM). The Work Plans for Work Package 3 (risk assessment) and Work Package 4 (focused feasibility study) are planned for future submittals.

1.2 Site Description

Patrick Bayou is a tributary of the Houston Ship Channel (HSC) in Harris County, Texas. The Site originates south of State Highway 225 in the City of Deer Park, Texas, and flows

approximately 2.5 miles in a northerly direction, discharging into the south side of the HSC approximately 2.3 miles upstream of its confluence with the San Jacinto River (Figure 1). The Site and its salient features are described in more detail in the *Preliminary Site Characterization Report* (PSCR; Anchor 2006), the *Work Package 2 Hydrodynamic Field Data Collection and Contaminant Source Evaluation Data Report* (Work Package 2 Data Report; Anchor 2007c), and the JDG responses to comments submitted on August 2, 2006. Information that relates directly to sediment transport issues within the Site was presented in Section 8 of the PSCR, and is included again below for completeness and for reference purposes.

The physical characteristics of the upstream portion of the Site are significantly different from the downstream portion. The upstream area is characterized by discharge from concrete culverts, gunite-lined side slopes with earthen bottom, and steeper hydraulic gradients, as compared to downstream areas, which are characterized by natural and armored banks and a low hydraulic gradient. Sediment thickness is relatively thin in the upstream reach and the concentrations of several contaminants of potential concern (COPCs) are observed to vary in space and with time, indicating the apparent effects of sediment transport.

The middle portion of the Site, from the end of the gunite-lined channel to the vegetated sand bar/island is characterized by thicker sequences of soft sediments. The sediment thickness in this portion appears to be controlled by physical hydraulic factors, such as channel morphology (e.g., depth and width) and structures (e.g., bridges and outfalls). The concentrations of several COPCs appear to change in space and with time in this reach also, again indicating the apparent effects of sediment transport.

The lower portion of the Site (towards the confluence with the HSC) is characterized by a more defined hydraulic channel, and a thick (up to 12 feet) sequence of soft sediments on the northern bank, indicating parts of that area has significant sediment deposition.

Benthic toxicity and benthic assemblage investigations by the Total Maximum Daily Load (TMDL) Lead Organization (Parsons et al., 2002; 2004) showed that both sediment toxicity and benthic assemblages varied with space and through time. These data and observations

are consistent with the documented observations of chemical, physical (grain size), and salinity changes seen throughout the Site. These and other confounding factors may be a causal factor for some of the observed toxicity in bioassay testing.

Sediment transport modeling was conducted using results from Cesium-137 and Lead-210 geochronology data analyzed as part of the Supplemental Work Plan from cores collected under Work Package 2. The model predicted the net sedimentation rate (NSR) of different areas within Patrick Bayou (Figure 2). Observations from the vertical coring investigations and sediment transport modeling indicate there is a significant amount of ongoing sedimentation in Patrick Bayou involving a mixture of new sediment entering the Site and redistribution of on-site materials. The current understanding of how ongoing sediment transport and deposition at the Site affects current and future potential ecological and human health risk posed by COPCs in surface sediments needs further clarification.

The following describes the current state of the Site sediment transport model and provides a basis for the recommended sediment sampling program. As described in the Supplemental Work Plan (Anchor 2007d), the sediment transport model used in this study is SEDZLJ, which is a model that Qualitative Environmental Analysis, L.L.C. (QEA) personnel have helped to develop over the last 20 years. This model is capable of predicting the erosion, deposition, and transport of fine-grained sediments (i.e., clay, silt, and fine sand), which is the primary type of sediment found at the Site.

The model was initially calibrated using total suspended solids (TSS) concentration data collected during the Work Package 2 October 2006 field study, and through comparison of predicted NSRs to values estimated from the analysis of the geochronology cores obtained and evaluated during Work Package 2 and the Supplemental Work Plan. A multi-year simulation was conducted using the calibrated model. Predicted bed elevation changes in the bayou at the end of the multi-year period were converted to NSRs for depositional areas of the Site based on 10 centimeters (cm) as the defined depth of the mixing zone. The predicted and estimated NSRs at the locations of the geochronology cores were compared to further calibrate and validate model results to date. Further description of the model is provided in the Supplemental Work Plan (Anchor 2007d), and a complete report on model development and results to date is in preparation.

2 SAMPLING DESIGN AND RATIONALE

The variability in the concentrations of COPCs in surface sediments at Patrick Bayou is a function of the following:

- Existing concentrations of COPCs in surface sediments
- Concentration of COPCs in new sediment entering the Site
- The thickness of the mixing layer
- The net sedimentation rate

The mixing layer represents the depth of sediment where biological and physical processes blend newly introduced sediment with pre-existing bed sediment.

2.1.1 Objectives and Rationale

The overall objective of this task is to validate and calibrate the sediment transport model for the Site by defining the thickness of the sediment mixing layer in Patrick Bayou and determining if it is spatially variable. This work builds upon the hydrodynamic data collection and preliminary modeling that was completed for the Site as part of the Work Package 2 and Supplemental Work Plan.

Secondary objectives related to the data collection efforts are to:

- Improve our understanding of the depositional history and temporal nature of contaminant sources by vertically profiling the Site surface sediments for bulk and radio chemistry
- Make visual observations regarding the presence/absence of benthic organisms

The data obtained from the high-resolution coring proposed in this Work Plan will be used to analyze vertical profiles of chemical, radioisotope, and bulk bed properties. Results of these analyses will also be used to further understand the potential variability in mixing layer thickness at the Site for sediment transport model calibration. The calibration/validation step involves matching observed chemical profiles and sedimentation rates as determined from the cores with sediment transport model results by using the mixing-layer thickness as a variable. Additional validation of the sediment transport model will be conducted using the radioisotope data (for NSRs) and grain size distribution data (for surface layer composition). This Work Plan provides an

opportunity for qualitative benthic organism assessment. Therefore, making observations of macrofauna is considered a secondary objective to support risk evaluations for both phases.

2.1.1.1 *Lead-210 Age Dating*

To refine and complement the net sedimentation rate data that were developed for the Site using Lead-210 analyses conducted under the Supplemental Work Plan, this Work Plan involves the analysis of additional Lead-210 data in shallow sediments (0 to 20 cm). This method of age dating sediments is described by Jeter (2000) and in the Supplemental Work Plan (Anchor 2007d). Lead-210 is a natural radioactive form of lead, which is found in small quantities in most soils as part of the uranium decay series. It is also produced as natural fallout from the atmosphere by radioactive decay of Radon-222 gas. Minute quantities of Lead-210 fall constantly onto the earth's surface. This material accompanies and mixes with sediments, which accumulate at the bottom of water systems. For a given locality, the supply of Lead-210 is often at a steady rate, being derived from direct deposition, from upstream transport, and from decay of Radon-222 in the water. The result is a relatively high concentration of Lead-210 in the shallow sediments (Jeter 2000).

Because of radioactive decay, excess Lead-210 (derived from natural fallout) is generally detectable to 100 years before the present. At depths corresponding to 100 years or older, the excess Lead-210 has decayed away and the measured concentration represents the background level that is characteristic of the sediment itself. If a logarithmic curve is fitted to a complete Lead-210 profile from the surface to the 100-year level, the sedimentation rate derived from the slope of the line represents an average over a 100-year timeframe. In areas where sedimentation rates have varied over time, different slopes can be identified in the Lead-210 concentration plots, allowing varying sedimentation rates to be derived.

2.1.2 *Study Design*

The study design for this investigation is depicted in Table 1 and is described in this section. High-resolution cores will be collected from 0 to 20 cm to provide vertical profiles of: 1) chemical concentrations; 2) radioisotope activity (i.e., Lead-210); and 3)

bulk bed properties (e.g., bulk density) to allow evaluation of the thickness of the mixing layer. Other types of bed data will include observations bed texture and extent of macroscopic benthic biota. Grain size distribution data will also be collected to further evaluate the cohesiveness of sediment and refine the sediment transport model in the lower portion of the Site. Based on the initial results of the model, this particular area may contain more sand than is currently assumed because of higher energy conditions.

2.1.2.1 Sample Locations and Intervals

High-resolution cores will be collected from 10 locations in Patrick Bayou (Figure 2)¹. These locations were determined using initial NSR modeling results. Five of these locations are from areas with relatively high NSRs (greater than 0.75 cm/year). Areas with these rates have a high probability of producing usable radiochemistry and chemical data for the model. The primary assumption for lead-210 data evaluation is that sedimentation is nearly constant, and we are assuming that areas with lower sedimentation rates will also have a lower probabilities of constant sedimentation. The other five locations are in areas with a lower NSR (0.5 to 0.75 cm/year). Although the lead-210 data from these cores may be un-interpretable, the chemistry profiles from these locations should provide valid calibration points. Each 20 cm core will be divided into 10, 2-cm slices. Every other slice (i.e., the “odd” slices), starting with 0 to 2 cm as the first odd slice, will be analyzed. The “even” slices, starting with 2 to 4 cm as the first even slice, will be archived by freezing for future use, if necessary. That is, if the results of the analyses identify additional data gaps in determining the mixing zone, those “even” slices that would fill the data gaps will be analyzed. Detail on collection and processing of these samples is provided in Section 4.6 and 4.7.1, respectively.

Sediment grab samples will also be collected at four stations in the lower portion of the Site for grain size distribution (GSD) analysis.

¹ For geographic reference, station identifiers are labeled using the convention PB###; the ### designates the approximate lateral distance from the downstream Site boundary with the HSC in hundreds of feet. For example, Station PB006 is located approximately 600 feet upstream from the Site boundary at the HSC.

2.1.2.2 *Parameters for Analysis*

Each odd slice sample will be analyzed for chemistry, radioisotope age dating and bulk properties, as detailed in the study design (Table 1). The list of chemicals outlined in Table 1 is based on evaluation of the vertical chemistry profiling conducted under Work Package 2 and includes chemicals that had significant and detectable concentration profiles over depth. The analytes for this Work Plan are those where the most significant concentration variations with depth were observed in previous vertical profiles and include:

- Total polycyclic aromatic hydrocarbons (PAHs; calculated using the standard 17 PAHs identified in Table 2)
- Mercury
- Polychlorinated biphenyl (PCB) Aroclors 1248 and 1254
- Hexachlorobutadiene

These COPCs are considered representative of the wide range of contaminants present at the Site and should provide the data required to determine the depth of the mixing zone in a cost-effective manner. PCB Aroclors (1248 and 1254) are being specifically analyzed for comparison to other Aroclors because these two were detected most frequently in results from previous data collection. Because of their frequency of detection (greater than 50 percent in the COPC screening dataset for Aroclor 1254 and 95 percent for Aroclor 1248), these Aroclors are assumed to be predominant source of Total PCBs at the Site. Other Aroclors were either not detected, or detected at a frequency less than 10 percent.

Additional sediment coring and laboratory analysis will be conducted as part of the Risk Assessment work to fully define the nature and extend of COPC distribution at the Site.

Lead-210 will be analyzed for the evaluation of radioisotope age dating.

Bulk properties parameters include:

- Bulk density
- GSD (as detailed in Table 2)

- Total organic carbon (TOC)
- Percent solids

Grain size distribution will be analyzed from grab sample locations shown on Figure 2; only samples that are composed of non-cohesive (i.e., sandy) sediment will be analyzed for GSD. The sediment bed in this portion of the bayou may be composed of non-cohesive sediment, and the model currently assumes that the bed is cohesive (muddy) in this region. The objective of collecting these GSD samples is to increase the predictive capability of the model in this specific area.

3 LABORATORY ANALYTICAL METHODS, QUALITY CONTROL, AND MEASUREMENT QUALITY OBJECTIVES

Analytical methods and the associated method reporting limits for sediment samples collected as part of this Work Plan are listed in Table 2. A summary of laboratory quality control samples and frequency of analysis for sediment sampling are listed in Table 3.

Laboratory measurement quality objectives for precision, accuracy, and completeness of sediment chemistry analysis for this Work Package are listed in Table 4.

4 FIELD ACTIVITY METHODS AND PROCEDURES

Details regarding project organization, schedule, contacts, access, utility clearance, and equipment are provided in this section.

4.1 Project Organization, Schedule, and Contacts

A comprehensive description of the project organization, schedule, and contacts is provided in the Quality Assurance Project Plan (QAPP) (submitted as part of the RI Work Plan; Anchor 2007a). For this study, Anchor Environmental, L.L.C. (Anchor) will conduct the field work. Both Anchor and QEA will analyze the data and QEA will utilize the results to further calibrate the sediment transport model.

4.2 Access and Sampling Permission

Anchor will identify access and permit requirements prior to field crew mobilization and coordinate with individual private property owners concerning specific sampling dates once access agreements have been executed.

The Site will be accessed through four privately owned facilities: Shell Oil – Deer Park Refining Services, Shell Chemical L.P. – Deer Park Chemical Plant, Lubrizol Corporation, and OxyVinyls L.P. The following personnel are facility-specific points of contact (POC) that will oversee the field activities occurring at their respective facilities:

- Jeff Stevenson– Shell Chemical – Deer Park Chemical Plant (backup for Shell Oil)
- Norman Mollard – Lubrizol Corporation
- Jeff Adamski – OxyVinyls L.P.

4.3 Utility Clearances

The nature of sampling activities is unlikely to create a hazard due to underground utilities or submerged pipelines; however, intrusive subsurface sampling activities will not be performed near any known or observable structures. Location of underground utilities will be coordinated with industrial facilities located along the Site boundaries. If underground or submerged utilities are present at a specific sampling location, the sampling location will be moved to avoid the utility.

4.4 Equipment, Supplies, and Sampling Containers

The analytical laboratory will provide certified, pre-cleaned, USEPA-approved containers for all samples. Sample containers for sediment are described in Table 5.

Necessary equipment, supplies, and sampling containers will be shipped or carried to the Site. Equipment and supplies may be shipped directly to the field from the vendor or to Anchor's Gulf Coast office for inspection prior to deployment or use in the field at the Site. All equipment and supplies will be inspected and tested as needed prior to field use.

4.5 Surveying

Horizontal positioning at each sampling location will be determined using a differential global positioning system (DGPS) with a handheld global positioning system (GPS) unit as backup if necessary. Station positions will be recorded in latitude and longitude to the nearest 0.01 second in the North American Datum 1983 (NAD 83). The accuracy of the horizontal coordinates will be within 3 meters.

Station locations for this Work Plan are summarized in Table 6.

4.6 Sample Collection Procedures

Cores will be collected using a box-core sampler manually driven to a minimum target penetration depth of 25 cm below mudline. Box-core samplers are optimal for soft bottom, large volume sampling and include a frame to add stability during sampling penetration. They can be constructed in various sizes and are typically constructed of stainless steel, aluminum, polyvinyl chloride (PVC) or fiberglass. Multiple discrete cores may be required to collect the necessary volume for the proposed analyses.

Prior to sampling, the core tubes will be decontaminated according to the procedures outlined in Section 4.8. Contact of the sample tube with potentially contaminated surfaces will be avoided or minimized to the extent possible during sampling. Extra sample tubes will be available during sample operations for uninterrupted sampling in the event of a potential core tube breakage or contamination. Core tubes suspected to have been accidentally contaminated will not be used. During deployment and retrieval of the coring device, care will be taken to ensure that the end of the core tube does not become

contaminated. When retrieved, each core will be inspected and a physical description of the material at the bottom of the core will be recorded.

Sediment cores will be inspected after they are secured on board the sampling vessel. Cores will be evaluated for acceptability using the following criteria:

- The sediment surface is relatively undisturbed
- The sampler was not inserted at angle or tilted upon retrieval based on a visual inspection of the coring unit
- At least 80 percent core recovery versus penetration is achieved

If a core fails to meet any of the above criteria, it will be rejected and the sediment will be placed back into the sampling area after acceptable sediments are retrieved. Sediment cores that meet the above stated criteria will be processed as described in Section 4.7.

Sediment grab samples for GSD analyses will be collect using a mini-ponar or similar device.

Sample collection activities will begin at the most downstream location and proceed upstream to minimize any potential for sample interference caused by disturbed sediment.

4.7 Sediment Processing

The following subsection details the sample processing procedures for sediment collection. All working surfaces and instruments used in the processing area will be thoroughly cleaned, decontaminated, and covered with aluminum foil to minimize outside contamination between sampling events (see Section 4.8). Disposable gloves will be discarded after processing each station and replaced prior to handling decontaminated instruments or work surfaces.

Sample containers will be kept in packaging as received from the analytical laboratory until use; a sample container will be withdrawn only when a sample is to be collected and will be returned to a cooler containing completed samples. Table 5 indicates holding times and preservatives.

4.7.1 High-Resolution Cores

Prior to processing, saturated sediment cores will be stored upright and processed as soon as practical, but in all cases within 6 hours. Maintaining a few inches of surface water in the core tubes prior to processing will ensure negligible change in redox conditions and prevent potential volatilization of COPCs. Cores will also be stored in a cool environment out of direct sunlight. The top 20 cm of each core will be processed as follows (depicted in Figure 3):

- The core will be separated into 10 2-cm samples using an extruder to obtain 2-cm interval samples.
- The five odd-numbered slices (slices 1, 3, 5, 7, and 9) will be sent to the analytical laboratory for analysis. This includes those slices with the following depth intervals in cm below mudline: 0 to 2, 4 to 6, 8 to 10, 12 to 14, and 16 to 18.
- The five even-numbered slices (slices 2, 4, 6, 8, and 10) will also be sent to the analytical laboratory where they will be frozen and archived. This includes the slices with the following depth intervals in cm below mudline: 2 to 4, 6 to 8, 10 to 12, 14 to 16, and 18 to 20.

As the sediment is being extruded, visual observations regarding presence/absence of benthic organisms will be noted to achieve the secondary objective as described in Section 2.1.1 of this Work Plan. Multiple box-core deployments may be required to obtain sufficient sediment volume for analysis. Additional cores may also be required at locations where QA/QC samples will be collected, as described in Section 4.9.1.

The specific steps are outlined as follows:

- Record the general description (including penetration and recovery) of the core on the appropriate log form as described in Section 5.1
- Proceed to extrude sediment at 2-cm slices into separate intermediate containers.
- Minimize sidewall contamination by only collecting sediments from the center of the core.
- If multiple box-core deployments are conducted, combine each sample into one stainless steel bowl per interval for homogenization.
- Samples will be homogenized in the field. Homogenization refers to the complete mixing of sediment to obtain consistency of physiochemical properties

throughout the sample prior to using in analyses (USEPA 2001). Samples will be homogenized prior to placing in the sample containers. The general procedure will consist of:

- Removing unrepresentative materials (twigs, shells, leaves, etc.) and documenting in the appropriate field log
- Quickly and efficiently mixing the sample
- Stirring the sediment until texture, color, and moisture homogeneity is achieved
- Using a clean, stainless steel spoon, completely fill pre-labeled sample containers, as indicated in Table 5.
- Immediately after filling the sample containers with sediment, place the screw cap on the sample container and tighten, wiping jar threads as necessary to ensure a tight seal.
- Thoroughly check all sample containers for proper identification, analysis type, and lid tightness.
- Pack each container carefully to prevent breakage and place inside of a cooler with ice for storage at the proper temperature (4°C for all samples).
- Mark samples submitted to the analytical laboratory designated for archiving on the sample containers, as well as on the custody forms (discussed in Section 5.2.1).

4.8 Decontamination

Sample collection equipment, containers, instruments, working surfaces, technician protective gear, and other items that may come into contact with sediment sample material must meet high standards of cleanliness. All equipment and instruments used that are in direct contact with the sediment collected for analysis will be made of glass, stainless steel, high density polyethylene (HDPE), or polytetrafluoroethylene (PTFE), and will be cleaned prior to each day's use and between sampling or handling. Decontamination of all items will follow USEPA protocols (1986). The decontamination procedure is as follows:

- Pre-wash rinse with tap water or site water
- Wash with solution of tap water and Alconox soap (brush)
- Rinse with tap water
- Rinse three times with distilled water

- Cover (no contact) all decontaminated items with aluminum foil
- Store in clean, closed container for next use

The Field Supervisor may elect to implement a hexane rinse if there are significant residues observed on field equipment after the above decontamination procedures are used.

4.9 Field Quality Assurance/Quality Control (QA/QC)

4.9.1 Field Quality Assurance Samples

Per the RI Work Plan QAPP (Anchor 2007a), field duplicates will be sampled and submitted for analysis at a frequency of 5 percent of samples submitted for bulk sediment chemistry and radiochemistry. Temperature indicators will be included in each container for shipment of bulk sediment chemistry to the laboratory.

4.9.2 Performance Audits and Corrective Actions

Performance audits and corrective actions will be performed per the RI Work Plan QAPP (Section 16; Anchor 2007a).

4.10 Investigation Derived Waste Handling and Tracking

This section provides a waste management plan for handling investigation derived waste associated with activities at the Site.

Investigation derived waste for this Work Plan is expected to consist of:

- Excess sediment generated during sampling (cores and slurries)
- Personal protective equipment (PPE) and other solid waste
- Decontamination and rinse water

4.10.1 Sediment

Generation of some excess sample material is anticipated during collection of cores. Whenever possible, core material will be returned to the environment by returning the sediment back to the collection site (Patrick Bayou).

Field sampling conditions (weather conditions or other unanticipated events, such as leaks or spills at adjacent industrial locations) may preclude safe disposal of excess

material at the time of sampling. If needed, excess sediments and slurries will be retained and stored in lined 10-gallon buckets for later return to the environment at the Site.

If needed, sediments and slurries will be retained and stored in lined 50-gallon drums for later disposal at an approved solid waste handling facility. Contents of the drums will be clearly marked. A log of collection dates and times, plus approximate volume of each sample, will be maintained to facilitate off-site disposal of the material as either non-hazardous or hazardous dredge spoil material.

4.10.2 Decontamination and Rinse Water

Decontamination and rinse water will be retained in lined 10-gallon buckets, and disposed of via the municipal sewer system. Dilution of COPCs by flushing with tap water and the additional dilution of COPCs by other sources of flow in the municipal sewer system should be sufficient to achieve non-hazardous levels or no appreciable increase in ambient COPCs. If decontamination occurs within a private facility (e.g., Shell, OxyVinyls, or Lubrizol), investigation-derived waste tracking and disposal procedures will be followed.

4.10.3 PPE and Solid Waste

PPE and solid waste will be decontaminated to the extent possible and disposed as municipal waste.

5 MEASUREMENT AND DATA ACQUISITION

This section describes the procedures for field documentation, sample identification, and handling/transporting sediment samples to the analytical laboratory.

5.1 Field Documentation and Sediment Sample Identification

Field sample logs and notebooks will be maintained for all samples collected during the field program. All sample field notebooks will have numbered pages. All data entries will be made using indelible-ink pens. Corrections will be made by drawing a single line through the error, writing in the correct information, then dating and initialing the change.

At a minimum, the following information will be included in the log for sediment cores:

1. The sample station number
2. Location of each sample station as determined by DGPS (with proper description of measurement units)
3. Date and collection time of each sediment sample
4. Names of field supervisor and person(s) collecting and logging the sample
5. Observations made during sample collection including weather conditions, complications, ship traffic, and other details associated with the sampling effort
6. Length and recovery for each sediment core
7. Qualitative notation of apparent resistance of sediment column to coring/sampling, including notes on debris
8. Any deviation from the approved Work Plan

During sediment sample processing, the following information should be recorded in the sample log sheet or field log:

1. Sample recovery (depth in centimeters of penetration and sample compaction)
2. Physical soil description in accordance with the Unified Soil Classification System (includes soil type, density/consistency of soil, and color)
3. Odor (e.g., hydrogen sulfide, petroleum, etc.) if any is passively observed
4. Vegetation
5. Debris
6. Biological activity (e.g., detritus, shells, tubes, bioturbation, or live or dead organisms)

7. Presence and depth (in centimeters) of the redox potential discontinuity layer
8. Presence of non-aqueous phase liquid (NAPL) sheen
9. Any other distinguishing characteristics or features

5.1.1 Sample Identification

Sample identification will include depth interval information and will follow the general project identification scheme for sediment cores described below. For example, for sample PB###-#XX###-X:

- PB###-#XX###-X: Each location will be identified by PB, to depict the project location (Patrick Bayou), and the station identifier associated with the channel station in hundreds of feet (e.g., PB100).
- PB###-#XX###-X: Individual samples at each location will be identified by the same alphanumeric identifier used to identify the stations, followed by a one-digit numeric substation identifier, a two-digit matrix identifier (i.e., SC = sediment core), and a three-digit number identifying the lower interval measurement (in cm) for that sample.
- PB###-#XX###-X: An alphanumeric identifier indicating the sample type:
 - N – normal sample
 - D – field duplicates or homogenization split of the normal sample

This information is included in detail for planned samples in Table 1. For samples collected from stations previously sampled, the unique substation identifier within the identification scheme will distinguish from previously collected data, as will the sample collection date, depth, and time associated with the sample.

5.2 Sample Handling and Transport

As described in the RI Work Plan QAPP (Anchor 2007a), components of sample custody procedures include the use of field logbooks, sample labels, custody seals, and chain-of-custody (COC) forms. Each person involved with sample handling will be trained in COC procedures before the start of the field program. The COC form will accompany the samples during shipment from the field to the laboratory.

5.2.1 Field Custody

The following procedures will be used to document, establish, and maintain custody of field samples:

1. Sample labels will be completed for each sample with waterproof ink, making sure that the labels are legible and affixed firmly on the sample container.
2. All sample-related information will be recorded in the project logbook.
3. The field sampler will retain custody of the samples until they are transferred or properly dispatched.
4. To simplify the COC record and minimize potential problems, as few people as possible should handle the samples. For this reason, one individual from the field sampling team will be designated as the responsible individual for all sample transfer activities. This field investigator will be responsible for the care and custody of the samples until they are properly transferred to another person or facility.
5. A COC form will accompany all samples. This record documents the transfer of custody of samples from the field sampler to the laboratory. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record.
6. Samples will be properly packaged for shipment and sent to the appropriate laboratory for analysis with a separate signed COC form, enclosed in a plastic bag, and taped inside the cover of each sample box or cooler. The original record will accompany the shipment, and a copy will be retained by the Field Supervisor. When samples are relinquished to shipping companies for transport, the tracking number will be recorded on the COC form.
7. The COC form must be signed when relinquished by field personnel and signed by the laboratory receiving the samples.
8. Custody seals will be used on the shipping containers when samples are shipped to the laboratory to inhibit sample tampering during transportation.

5.2.2 Laboratory Sample Custody

Each laboratory receiving samples for this project must comply with the laboratory sample custody requirements outlined in its Quality Assurance Plan (QAP). The laboratory will designate a sample custodian who will be responsible for maintaining

custody of the samples and all associated records documenting that custody. In addition, the laboratory will provide the following quality checks:

- The laboratory will check to see that there has been no tampering with the custody seals on the coolers.
- Upon receipt of the samples, the custodian will check the original COC and request-for-analysis documents and compare them with the labeled contents of each sample container for corrections and traceability. The sample custodian will sign the COC and record the date and time received in the 'Received by Laboratory' box.
- The sample custodian also will assign a unique laboratory sample number to each sample.
- Cooler temperature will be checked and recorded.
- Care will be exercised to annotate any labeling or descriptive errors. If discrepancies occur in the documentation, the laboratory will immediately contact the sample tracking coordinator and Anchor Project Chemist as part of the corrective action process. A qualitative assessment of each sample container will be performed to note anomalies, such as broken or leaking bottles. This assessment will be recorded as part of the incoming COC procedure.

Samples will be stored in a secured area and at a temperature of $4^{\circ} \pm 2^{\circ}\text{C}$, if necessary, until analyses are to begin. Unless otherwise specified by the Project Manager, samples will be retained for a period of 60 days after the final report is released by the laboratory, after which they will be disposed in accordance with the laboratory Standard Operating Procedures (SOP) for waste disposal. Samples submitted to the laboratory marked for archive on the COC and sample container will be frozen and stored until further notice.

5.2.3 Sample Packing and Shipping

During the field efforts, the Anchor Project Chemist will notify the appropriate laboratories about sample shipments. The Anchor Field Supervisor will fax copies of the COC to the Laboratory Project Manager for each day of sampling.

Hard plastic ice chests or coolers with similar durability will be used for shipping samples. The coolers must be able to withstand a 4-foot drop onto solid concrete in the

position most likely to cause damage. Samples will be double-bagged in Ziploc bags and grouped by sample set. Styrofoam or bubble wrap will be used as packing material to protect the samples from leakage during shipment. A volume of ice approximately equal to the sample volume should be present in each cooler. Blue ice will not be used. After packing is complete, the cooler will be taped securely, with custody seals affixed across the top and bottom joints. In addition, these procedures will be followed when packing coolers of samples for shipping:

1. Include absorbent material in the cooler to absorb any ice melt.
2. Record the airbill on each COC.
3. List the appropriate contact person on the COC.
4. Use custody seals on the cooler.

Samples will be shipped priority overnight FedEx or transported by courier (or equivalent) to the laboratory.

6 REFERENCES

- Anchor Environmental, L.L.C. (Anchor). 2006. Preliminary Site Characterization Report. Patrick Bayou Superfund Site. Deer Park, Texas. Prepared for USEPA and Patrick Bayou Joint Defense Group.
- Anchor. 2007a. Remedial Investigation Work Plan. Patrick Bayou Superfund Site. Deer Park, Texas. Prepared for USEPA and Patrick Bayou Joint Defense Group. January 8, 2007.
- Anchor. 2007b. Hydrodynamic Field Data Collection and Contaminant Source Evaluation Work Plan. Patrick Bayou Superfund Site. Deer Park, Texas. Prepared for USEPA and Patrick Bayou Joint Defense Group. January 8, 2007.
- Anchor. 2007e. Work Package 2 – Vertical Profiling Hydrodynamic Field Data Collection and Contaminant Source Evaluation Data Report. Patrick Bayou Superfund Site, Deer Park, Texas. Prepared for USEPA and Patrick Bayou Joint Defense Group. April 5, 2007.
- Anchor. 2007f. Draft Supplemental Work Plan. Additional Hydrodynamic Data Collection, Geotechnical Data Collection, Sediment Accretion Evaluations and Porewater Sampling and Estimation of Distribution Coefficients. Patrick Bayou Superfund Site, Deer Park, Texas. Prepared for USEPA and Patrick Bayou Joint Defense Group. May 10, 2007.
- Buchman, MF. 1999. NOAA Screening Quick Reference Table. NOAA HAZMAT Report, 99-1. Seattle WA, Coastal Protection and Restoration Division. National Atmospheric and Oceanic Administration.
- Jeter, H.W. 2000. Determining the ages of recent sediments using measurements of trace radioactivity. *Terra et Aqua*. Number 78. March 2000. pp.21-28.
- Parsons Engineering Science et al. 2002. Assessment of sediment toxicity and quality in Patrick Bayou, Segment 1006, Harris County, Texas. Prepared for Patrick Bayou TMDL Lead Organization, November 2002

Parsons Engineering Science et al. 2004. Assessment of sediment toxicity and quality in Patrick Bayou, Segment 1006, Harris County, Texas. Prepared for Patrick Bayou TMDL Lead Organization.

U.S. Environmental Protection Agency (USEPA). 1986. General QA/QC consideration for collecting environmental samples in Puget Sound. U.S. Environmental Protection Agency, Region 10, Office of Puget Sound Estuary Program, Seattle, WA.

USEPA. 2001. Methods for collection, storage, and manipulation of sediments for chemical and toxicological analyses: technical manual. Office of Water. EPA-823-B-01-002

TABLES

Table 1
Summary of High-Resolution Sediment Core Study Design

Station ID ^c	Sample ID	Depth Interval (cm) ^c	Station Coordinates ^a		Archived	Bulk Density	Lead 210 ^d	TOC	% Solids	Grain Size	PAHs (17) ^b	Mercury	HCBd	PCB 1248 & 1254 ^b
			Latitude	Longitude										
PB-006	PB006-1SC002-N	0-2	29 44 13.819	95 06 41.778		X	X	X	X		X	X	X	X
	PB006-2SC004-N	2-4	29 44 13.819	95 06 41.778	X									
	PB006-3SC006-N	4-6	29 44 13.819	95 06 41.778		X	X	X	X		X	X	X	X
	PB006-4SC008-N	6-8	29 44 13.819	95 06 41.778	X									
	PB006-5SC010-N	8-10	29 44 13.819	95 06 41.778		X	X	X	X		X	X	X	X
	PB006-6SC012-N	10-12	29 44 13.819	95 06 41.778	X									
	PB006-7SC014-N	12-14	29 44 13.819	95 06 41.778		X	X	X	X		X	X	X	X
	PB006-8SC016-N	14-16	29 44 13.819	95 06 41.778	X									
	PB006-9SC018-N	16-18	29 44 13.819	95 06 41.778		X	X	X	X		X	X	X	X
	PB006-10SC020-N	18-20	29 44 13.819	95 06 41.778	X									
PB-007	PB007-1SC002-N	0-2	29 44 16.004	95 06 43.550		X	X	X	X		X	X	X	X
	PB007-2SC004-N	2-4	29 44 16.004	95 06 43.550	X									
	PB007-3SC006-N	4-6	29 44 16.004	95 06 43.550		X	X	X	X		X	X	X	X
	PB007-4SC008-N	6-8	29 44 16.004	95 06 43.550	X									
	PB007-5SC010-N	8-10	29 44 16.004	95 06 43.550		X	X	X	X		X	X	X	X
	PB007-6SC012-N	10-12	29 44 16.004	95 06 43.550	X									
	PB007-7SC014-N	12-14	29 44 16.004	95 06 43.550		X	X	X	X		X	X	X	X
	PB007-8SC016-N	14-16	29 44 16.004	95 06 43.550	X									
	PB007-9SC018-N	16-18	29 44 16.004	95 06 43.550		X	X	X	X		X	X	X	X
	PB007-10SC020-N	18-20	29 44 16.004	95 06 43.550	X									
PB-016	PB016-1SC002-N	0-2	29 44 14.899	95 06 53.589		X	X	X	X		X	X	X	X
	PB016-2SC004-N	2-4	29 44 14.899	95 06 53.589	X									
	PB016-3SC006-N	4-6	29 44 14.899	95 06 53.589		X	X	X	X		X	X	X	X
	PB016-4SC008-N	6-8	29 44 14.899	95 06 53.589	X									
	PB016-5SC010-N	8-10	29 44 14.899	95 06 53.589		X	X	X	X		X	X	X	X
	PB016-6SC012-N	10-12	29 44 14.899	95 06 53.589	X									
	PB016-7SC014-N	12-14	29 44 14.899	95 06 53.589		X	X	X	X		X	X	X	X
	PB016-8SC016-N	14-16	29 44 14.899	95 06 53.589	X									
	PB016-9SC018-N	16-18	29 44 14.899	95 06 53.589		X	X	X	X		X	X	X	X

Table 1
Summary of High-Resolution Sediment Core Study Design

Station ID ^c	Sample ID	Depth Interval (cm) ^c	Station Coordinates ^a		Archived	Bulk Density	Lead 210 ^d	TOC	% Solids	Grain Size	PAHs (17) ^b	Mercury	HCBd	PCB 1248 & 1254 ^b
			Latitude	Longitude										
PB-016	PB016-10SC020-N	18-20	29 44 14.99	95 06 53.589	X									
PB-021	PB021-1SC002-N	0-2	29 44 09.571	95 06 54.429		X	X	X	X		X	X	X	X
	PB021-2SC004-N	2-4	29 44 09.571	95 06 54.429	X									
	PB021-3SC006-N	4-6	29 44 09.571	95 06 54.429		X	X	X	X		X	X	X	X
	PB021-4SC008-N	6-8	29 44 09.571	95 06 54.429	X									
	PB021-5SC010-N	8-10	29 44 09.571	95 06 54.429		X	X	X	X		X	X	X	X
	PB021-6SC012-N	10-12	29 44 09.571	95 06 54.429	X									
	PB021-7SC014-N	12-14	29 44 09.571	95 06 54.429		X	X	X	X		X	X	X	X
	PB021-8SC016-N	14-16	29 44 09.571	95 06 54.429	X									
	PB021-9SC018-N	16-18	29 44 09.571	95 06 54.429		X	X	X	X		X	X	X	X
	PB021-10SC020-N	18-20	29 44 09.571	95 06 54.429	X									
PB-025	PB025-1SC002-N	0-2	29 44 06.303	95 06 53.264		X	X	X	X		X	X	X	X
	PB025-2SC004-N	2-4	29 44 06.303	95 06 53.264	X									
	PB025-3SC006-N	4-6	29 44 06.303	95 06 53.264		X	X	X	X		X	X	X	X
	PB025-4SC008-N	6-8	29 44 06.303	95 06 53.264	X									
	PB025-5SC010-N	8-10	29 44 06.303	95 06 53.264		X	X	X	X		X	X	X	X
	PB025-6SC012-N	10-12	29 44 06.303	95 06 53.264	X									
	PB025-7SC014-N	12-14	29 44 06.303	95 06 53.264		X	X	X	X		X	X	X	X
	PB025-8SC016-N	14-16	29 44 06.303	95 06 53.264	X									
	PB025-9SC018-N	16-18	29 44 06.303	95 06 53.264		X	X	X	X		X	X	X	X
	PB025-10SC020-N	18-20	29 44 06.303	95 06 53.264	X									
PB-041	PB041-1SC002-N	0-2	29 43 49.969	95 06 52.436		X	X	X	X		X	X	X	X
	PB041-2SC004-N	2-4	29 43 49.969	95 06 52.436	X									
	PB041-3SC006-N	4-6	29 43 49.969	95 06 52.436		X	X	X	X		X	X	X	X
	PB041-4SC008-N	6-8	29 43 49.969	95 06 52.436	X									
	PB041-5SC010-N	8-10	29 43 49.969	95 06 52.436		X	X	X	X		X	X	X	X
	PB041-6SC012-N	10-12	29 43 49.969	95 06 52.436	X									
	PB041-7SC014-N	12-14	29 43 49.969	95 06 52.436		X	X	X	X		X	X	X	X
	PB041-8SC016-N	14-16	29 43 49.969	95 06 52.436	X									

Table 1
Summary of High-Resolution Sediment Core Study Design

Station ID ^c	Sample ID	Depth Interval (cm) ^c	Station Coordinates ^a		Archived	Bulk Density	Lead 210 ^d	TOC	% Solids	Grain Size	PAHs (17) ^b	Mercury	HCBd	PCB 1248 & 1254 ^b
			Latitude	Longitude										
PB-041	PB041-9SC018-N	16-18	29 43 49.969	95 06 52.436		X	X	X	X		X	X	X	X
	PB041-10SC020-N	18-20	29 43 49.969	95 06 52.436	X									
PB-046	PB046-1SC002-N	0-2	29 43 45.121	95 06 49.829		X	X	X	X		X	X	X	X
	PB046-2SC004-N	2-4	29 43 45.121	95 06 49.829	X									
	PB046-3SC006-N	4-6	29 43 45.121	95 06 49.829		X	X	X	X		X	X	X	X
	PB046-4SC008-N	6-8	29 43 45.121	95 06 49.829	X									
	PB046-5SC010-N	8-10	29 43 45.121	95 06 49.829		X	X	X	X		X	X	X	X
	PB046-6SC012-N	10-12	29 43 45.121	95 06 49.829	X									
	PB046-7SC014-N	12-14	29 43 45.121	95 06 49.829		X	X	X	X		X	X	X	X
	PB046-8SC016-N	14-16	29 43 45.121	95 06 49.829	X									
	PB046-9SC018-N	16-18	29 43 45.121	95 06 49.829		X	X	X	X		X	X	X	X
	PB046-10SC020-N	18-20	29 43 45.121	95 06 49.829	X									
PB-052	PB052-1SC002-N	0-2	29 43 39.220	95 06 52.684		X	X	X	X		X	X	X	X
	PB052-2SC004-N	2-4	29 43 39.220	95 06 52.684	X									
	PB052-3SC006-N	4-6	29 43 39.220	95 06 52.684		X	X	X	X		X	X	X	X
	PB052-4SC008-N	6-8	29 43 39.220	95 06 52.684	X									
	PB052-5SC010-N	8-10	29 43 39.220	95 06 52.684		X	X	X	X		X	X	X	X
	PB052-6SC012-N	10-12	29 43 39.220	95 06 52.684	X									
	PB052-7SC014-N	12-14	29 43 39.220	95 06 52.684		X	X	X	X		X	X	X	X
	PB052-8SC016-N	14-16	29 43 39.220	95 06 52.684	X									
	PB052-9SC018-N	16-18	29 43 39.220	95 06 52.684		X	X	X	X		X	X	X	X
	PB052-10SC020-N	18-20	29 43 39.220	95 06 52.684	X									
PB-058	PB058-1SC002-N	0-2	29 43 33.171	95 06 50.373		X	X	X	X		X	X	X	X
	PB058-2SC004-N	2-4	29 43 33.171	95 06 50.373	X									
	PB058-3SC006-N	4-6	29 43 33.171	95 06 50.373		X	X	X	X		X	X	X	X
	PB058-4SC008-N	6-8	29 43 33.171	95 06 50.373	X									
	PB058-5SC010-N	8-10	29 43 33.171	95 06 50.373		X	X	X	X		X	X	X	X
	PB058-6SC012-N	10-12	29 43 33.171	95 06 50.373	X									
	PB058-7SC014-N	12-14	29 43 33.171	95 06 50.373		X	X	X	X		X	X	X	X

Table 1
Summary of High-Resolution Sediment Core Study Design

Station ID ^c	Sample ID	Depth Interval (cm) ^c	Station Coordinates ^a		Archived	Bulk Density	Lead 210 ^d	TOC	% Solids	Grain Size	PAHs (17) ^b	Mercury	HCBd	PCB 1248 & 1254 ^b
			Latitude	Longitude										
PB-058	PB058-8SC016-N	14-16	29 43 33.171	95 06 50.373	X									
	PB058-9SC018-N	16-18	29 43 33.171	95 06 50.373		X	X	X	X		X	X	X	X
	PB058-10SC020-N	18-20	29 43 33.171	95 06 50.373	X									
PB-063	PB063-1SC002-N	0-2	29 43 29.161	95 06 51.764		X	X	X	X		X	X	X	X
	PB063-2SC004-N	2-4	29 43 29.161	95 06 51.764	X									
	PB063-3SC006-N	4-6	29 43 29.161	95 06 51.764		X	X	X	X		X	X	X	X
	PB063-4SC008-N	6-8	29 43 29.161	95 06 51.764	X									
	PB063-5SC010-N	8-10	29 43 29.161	95 06 51.764		X	X	X	X		X	X	X	X
	PB063-6SC012-N	10-12	29 43 29.161	95 06 51.764	X									
	PB063-7SC014-N	12-14	29 43 29.161	95 06 51.764		X	X	X	X		X	X	X	X
	PB063-8SC016-N	14-16	29 43 29.161	95 06 51.764	X									
	PB063-9SC018-N	16-18	29 43 29.161	95 06 51.764		X	X	X	X		X	X	X	X
	PB063-10SC020-N	18-20	29 43 29.161	95 06 51.764	X									
PB-008	PB008-1SG010-N	0-10	29 44 15.899	95 06 44.540						X				
PB-009	PB009-1SG010-N	0-10	29 44 15.671	95 06 46.058						X				
PB-011	PB011-1SG010-N	0-10	29 44 15.556	95 06 47.066						X				
PB-012	PB012-1SG010-N	0-10	29 44 15.434	95 06 48.175						X				
Field Quality Assurance /Quality Control Samples														
PB### ^e	PB###-XX###-D		TBD	TBD		3 ^f	3 ^f	3 ^f	3 ^f	1 ^f	3 ^f	3 ^f	3 ^f	3 ^f

Notes:

- a Station Coordinates are State Plane coordinates based on North American Datum (NAD) 83 for Texas, South Central
- b See Table 2 for complete list of analytes/congeners included in analyses
- c Specific station and interval may be changed in the field to best represent site conditions
- d Radioisotope analysis for Lead 210 will be performed on this interval; number of intervals per site will be dependent on sediment depth
- e Location to be determined in field based on site conditions. Samples to be named in accordance with Section 5.1.1
- f Represent the number of samples to be taken for each analyte class
- HCBd Hexachlorobutadiene
- TBD To be determined

Table 2
Parameters for Analysis and Target Practical Quantitation Limits

	Units	Sediment Target PQL	Analytical Method
Conventional Parameters			
Gravel	%	0.1	PSEP
Sand	%	0.1	PSEP
Silt	%	0.1	PSEP
Clay	%	0.1	PSEP
Fines	%	0.1	PSEP
Total Solids	%	0.1	160.3
Total organic Carbon	%	0.1	9060A
Metals			
Mercury	mg/kg	0.05	7470A/7471A
Radiochemistry			
Lead ²¹⁰	pCi/g	0.1	MSS-PRO-006
Semivolatile Organics			
LPAH			
2-Methylnaphthalene	µg/kg	6.7	8270C/ SIM
Acenaphthene	µg/kg	6.7	8270C/ SIM
Acenaphthylene	µg/kg	6.7	8270C/ SIM
Anthracene	µg/kg	6.7	8270C/ SIM
Fluorene	µg/kg	6.7	8270C/ SIM
Naphthalene	µg/kg	6.7	8270C/ SIM
Phenanthrene	µg/kg	6.7	8270C/ SIM
HPAH			
Benzo(a)anthracene	µg/kg	6.7	8270C/ SIM
Benzo(a)pyrene	µg/kg	6.7	8270C/ SIM
Benzo(b)fluoranthene	µg/kg	6.7	8270C/ SIM
Benzo(g,h,i)perylene	µg/kg	6.7	8270C/ SIM
Benzo(k)fluoranthene	µg/kg	6.7	8270C/ SIM
Chrysene	µg/kg	6.7	8270C/ SIM
Dibenzo(a,h)anthracene	µg/kg	6.7	8270C/ SIM
Indeno(1,2,3-cd)pyrene	µg/kg	6.7	8270C/ SIM
Fluoranthene	µg/kg	6.7	8270C/ SIM
Pyrene	µg/kg	6.7	8270C/ SIM
Other Semivolatile Organics			
Hexachlorobutadiene	µg/kg	1	8081A
PCBs			
Total PCB Aroclors	µg/kg	1.6	8082
Aroclor 1248	µg/kg	1.6	8082
Aroclor 1254	µg/kg	1.6	8082

Notes:

PQL - Practical quantitation limit

µg/kg - micrograms per kilogram

*Source: Buchanan 1999

pCi/g - picocuries per gram

PSEP - Puget Sound Estuary Program

Table 3
Laboratory Quality Control Sample Summary

Analysis Type	Method	Initial Calibration	Ongoing Calibration	Standard Reference Material for LCS/LCSD	Replicates	Matrix Spikes	Matrix Spike Duplicates	Method Blanks	Surrogate Spikes
Bulk density	D2937	Each batch	NA	NA	1 per 20 samples	NA	NA	NA	NA
Lead-210	MSS-PRO-066	Yearly	Twice weekly ^b	1 per 20 samples ^{d,e}	1 per 20 samples	1 per 20 samples ^{d,e}	1 per 20 samples ^{d,e}	1 per 20 samples ^{d,e}	NA
TOC	9060A	Daily or each batch	1 per 10 samples ^b	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	Each batch	NA
% Solids	160.3	Each batch	NA	NA	1 per 20 samples	NA	NA	NA	NA
Grain Size	PSEP	Each batch ^a	NA	NA	1 per 20 samples	NA	NA	NA	NA
Mercury	7470A/7471A	Daily or each batch	1 per 10 samples ^b	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	Each batch	NA
PCB 1248 and 1254	8082	As needed ^c	1 per 10 samples ^b	1 per 20 samples	NA	1 per 20 samples	1 per 20 samples	Each batch	Every sample
SVOCs, PAHs	8270C/SIM	As needed ^c	Every 12 hours ^b	1 per 20 samples	NA	1 per 20 samples	1 per 20 samples	Each batch	Every sample

Notes:

a - Calibration and certification of drying ovens and weighing scales are conducted bi-annually.

b - Initial calibration verification and calibration blank must be analyzed at the beginning of each batch.

c - Initial calibrations considered valid until ongoing continuing calibration no longer meets method specifications. At that point, a new initial calibration is performed.

d - Standard reference material is not applicable for this analysis.

e - If sufficient material is available

NA - Not Applicable

LCS/LCSD - Laboratory control sample/laboratory control sample duplicate

Table 4
Laboratory Measurement Objectives for Sediment Samples

Parameter	Method	Precision	Accuracy	Completeness
Bulk density	D2937	+/- 20% RPD	NA	95%
Lead-210	MSS-PRO-066	+/- 25% RPD	65-135% R	95%
TOC	9060A	+/- 20% RPD	65-130% R	95%
% Solids	160.3	+/- 20% RPD	NA	95%
Grain Size	PSEP	+/- 20% RPD	NA	95%
PAHs	8270C/SIM	+/- 50% RPD	50-140% R	95%
Mercury	7470A/7471A	+/- 50% RPD	65-130% R	95%
PCB 1248 and 1254	8082	+/- 50% RPD	50-140% R	95%
SVOCs	8270C/ SIM	+/- 50% RPD	50-140% R	95%

Notes:

RPD - Relative percent difference

R - Recovery

Table 5
Sample Containers, Preservatives, and Holding Times

Parameter	Method	Container Size and Type	Holding Time	Preservative
Bulk density	D2937	8-oz glass	6 months	Cool/4°C
Lead 210	MSS-PRO-066	4-oz glass	NA	NA
TOC	9060A	4-oz glass	28 days	Cool/4°C
			6 months	Freeze/-18°C
Grain Size	D422	16-oz plastic	6 months	Cool/4°C
% Solids	160.3	With grain size	14 days	Cool/4°C
			6 months	Freeze/-18°C
SVOCs, PAHs	8270C/SIM	16-oz glass	14 days until extraction, 40 days to analysis	Cool/4°C
			1 year until extraction, 40 days to analysis	Freeze/-18°C
PCB 1248 and 1254	8081A/8082	16-oz glass	14 days until extraction, 40 days to analysis	Cool/4°C
			1 year until extraction, 40 days to analysis	Freeze/-18°C
Mercury	7470A/7471A	With metals	28 days until analysis	Cool/4°C

Notes:

PCB - polychlorinated biphenyls

SVOC - semivolatile organic compounds

NA - not applicable

Table 6
Summary Sampling Station Location Coordinates

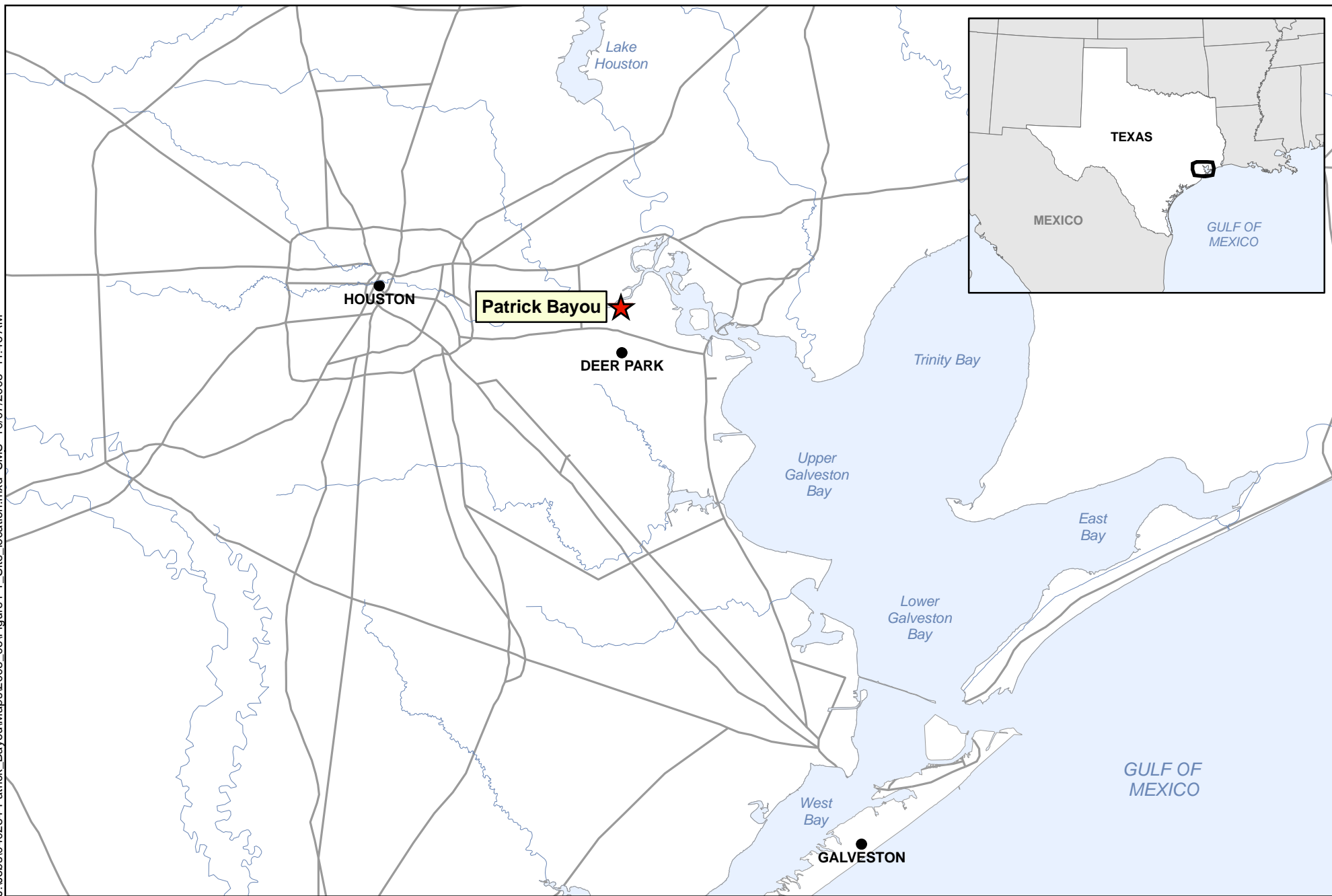
Core ID	Latitude	Longitude	Sample Type
PB-006	29 44 13.819	95 06 41.778	hi-resolution core
PB-007	29 44 16.004	95 06 43.550	hi-resolution core
PB-008	29 44 15.899	95 06 44.540	grab
PB-009	29 44 15.671	95 06 46.058	grab
PB-011	29 44 15.556	95 06 47.066	grab
PB-012	29 44 15.435	95 06 48.175	grab
PB-016	29 44 14.990	95 06 53.589	hi-resolution core
PB-021	29 44 09.571	95 06 54.429	hi-resolution core
PB-025	29 44 06.303	95 06 53.264	hi-resolution core
PB-041	29 43 49.969	95 06 52.436	hi-resolution core
PB-046	29 43 45.121	95 06 49.829	hi-resolution core
PB-052	29 43 39.220	95 06 52.684	hi-resolution core
PB-058	29 43 33.171	95 06 50.373	hi-resolution core
PB-063	29 43 29.161	95 06 51.764	hi-resolution core

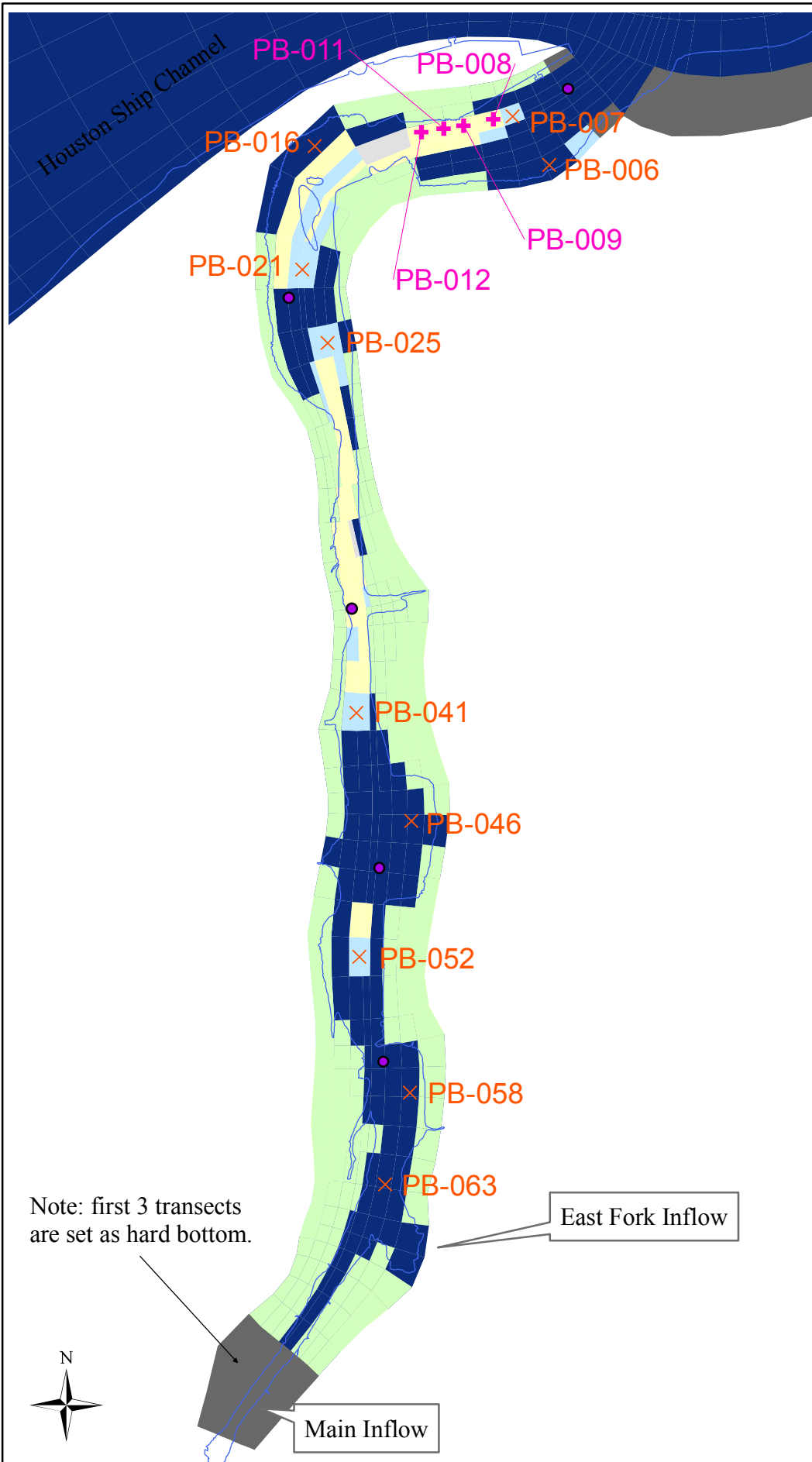
Note:

(1) Horizontal datum is NAD83 StatePlane Texas South Central, feet.

FIGURES

J:\Jobs\040284-Patrick Bayou\Maps\2008_06\Figure1-1_Site_location.mxd SMS 10/07/2008 11:46 AM

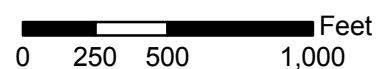




LOCATOR MAP



GRAPHIC SCALE



LEGEND

- + Proposed GSD Grab Sample Location
- × Proposed High-Resolution Sediment Core Location
- Existing Geochron Core Location
- Shoreline
- Hard bottom
- Floodplain

Sedimentation Rate (cm/yr)

- Net Erosion
- 0 - 0.5
- 0.5 - 0.75
- > 0.75

PATRICK BAYOU NEAR DEER PARK, TX

Predicted Sedimentation Rates, 1993 to 2006 and Proposed Vertical Coring Locations.



DEMpat:124

October 2008

